

## Risk Assessment Basics

U.S. Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) rules are risk-based.

**Risk** is the probability of harm.

It is important to distinguish between:

**Risk assessment** (evaluating what the risk is) and

**Risk management** (deciding how best to deal with the risk).

Elements of risk assessment:

- 1) Hazard identification
- 2) Exposure assessment
- 3) Toxicity assessment
- 4) Risk characterization

1) **Hazard identification** – what are the chemicals of interest?

2) The **exposure assessment** evaluates how much of the chemical you are exposed to (the dose). There are three important elements to an exposure assessment.

Source → Pathway → Receptor (people)

Many different pathways were evaluated in Portland Harbor.

3) The **toxicity assessment** evaluates how inherently bad (toxic) the chemical is. A basic principle of toxicology is that all chemicals are toxic.

The dose determines whether a chemical is poisonous or not. See Figure 1.

4) **Risk characterization**

Non-cancer and cancer effects are evaluated differently.

A **non-cancer** evaluation uses a dose threshold (reference dose, RfD), above which the risk (hazard) may be unacceptable, below which the risk is acceptable.

Hazard quotient = Actual dose / Acceptable dose

Any hazard quotient less than 1 is acceptable.

We also look at the sum of hazard quotients (= hazard index).

A **cancer** evaluation assumes there is no safe threshold. Risk is calculated as the probability of getting cancer.

Risk = Dose \* Toxicity = (Concentration \* Intake) \* Toxicity

EPA's acceptable excess lifetime cancer risk range is one-in-one-million to one-in-ten-thousand.

Oregon DEQ's acceptable risk is one-in-one-million for individual carcinogens; one-in-one-hundred-thousand for multiple carcinogens.

Risk assessments can be very complicated, but the basic elements are simple. Risk is the combination of exposure and toxicity. All the rest are details.

We have been discussing the approach for a human health risk assessment. Ecological risk assessment is more difficult, but follows the same basic principles.

EPA and DEQ require an evaluation of the effects of **multiple chemicals**.

EPA and DEQ also require an evaluation of **uncertainty**.

### **Preliminary Remediation Goals (Cleanup Levels)**

$$\text{Acceptable Concentration} = \text{Acceptable Risk} / (\text{Intake} * \text{Toxicity})$$

Risk is an important element, but we also use other elements (such as cost and implementability) to select a remedy for a site.

**Figure 1. Toxicity Dose/Response Curve**

